

Surgical Pathology Resident Rotation Restructuring at a Tertiary Care Academic Center

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Abstract

Changes in the field of pathology and resident education necessitate ongoing evaluation of residency training. Evolutionary change is particularly important for surgical pathology rotations, which form the core of anatomic pathology training programs. In the past, we organized this rotation based on subjective insight. When faced with the recent need to restructure the rotation, we strove for a more evidence-based process. Our approach involved 2 primary sources of data. We quantified the number of cases and blocks submitted per case type to estimate workload and surveyed residents about the time required to gross specimens in all organ systems. A multidisciplinary committee including faculty, residents, and staff evaluated the results and used the data to model how various changes to the rotation would affect resident workload, turnaround time, and other variables. Finally, we identified rotation structures that equally distributed work and created a point-based system that capped grossing time for residents of different experience. Following implementation, we retrospectively compared turnaround time and duty hour violations before and after these changes and surveyed residents about their experiences with both systems. We evaluated the accuracy of the point-based system by examining grossing times and comparing them to the assigned point values. We found overall improvement in the rotation following the implementation. As there is essentially no literature on the subject of surgical pathology rotation organization, we hope that our experience will provide a road map to improve pathology resident education at other institutions.

Keywords

academic residency, organizational strategies, pathology education, resident rotations, surgical pathology

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Introduction

As the practice of pathology continues to evolve, pathology residency training must address changes in the field to ensure a competent and successful workforce. In addition to the changing landscape of the field itself, the Accreditation Council for Graduate Medical Education (ACGME) now has greater oversight of training in order to standardize training between institutions and ensure safe patient care.¹ With these changes comes the need to evaluate and restructure essential residency rotations. The study of surgical pathology is central to all anatomic pathology residency programs, therefore the structure of

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surgical pathology training is critical to the success of pathology programs and their residents.

In the ever-changing medical landscape, pathology residency programs must be mindful of the expectations of employers and the ongoing changes to the practice of pathology within the complex health-care system. Employers note that more guidance and support are needed for newly trained pathologists as compared to 10 years ago.² With the increasing need for knowledge in emerging fields such as informatics³ and highly evolving fields such as molecular diagnostics,⁴ there continues to be a wealth of information that needs to be taught in a diminishing amount of residency time. Recent publications also stress the importance of nondiagnostic factors in securing jobs such as communication, problem-solving, networking skills, and professionalism.⁵ There is also increasing dialogue about the need to train pathologists who can lead and be part of health-care teams.⁶ Therefore, techniques that help programs better understand how residents are allocating their time provide knowledge that can be used in the organization of training. This is ultimately important in helping trainees successfully secure jobs and ensuring an appropriate knowledge base for the emerging pathology workforce.

In 2007, our institution, The Hospital of the University of Pennsylvania, changed its practice pattern from general pathology sign out to subspecialty sign out. As a result, the surgical pathology rotation was drastically overhauled. The process by which the rotation was altered was not evidence based. The residency workflow was divided into 10 subspecialties. These 10 subspecialties were arbitrarily divided into 2 services (SP1 and SP2) each with a 4-day cycle and required 8 residents to be on the surgical pathology rotation during any given month. SP1 consisted of gynecologic pathology, head and neck pathology, endocrine pathology, breast pathology, and dermatopathology and SP2 consisted of gastrointestinal pathology, genitourinary pathology, soft tissue pathology, cardiac pathology, pulmonary pathology, and miscellaneous specimens. Residents were required to rotate through 6 months of each service, and no clear elements of graduated responsibility were incorporated. The 4-day cycle consisted of a day of frozen section/specimen preparation, a day of grossing, a day of reviewing, and concluded with a day of sign out. Although this system worked for some time, by the end of 2012, it was clear a restructuring of the rotation was needed.

The factors that contributed to the need for restructuring were diverse and came from various sections within the department. Time had proven it difficult to staff the rotation with 8 residents per month due to the increasing demands on the residency schedule created by new rotations and changes in ACGME work hour regulations. Increases in specimen volume, variations in operating room schedules, changes to the histology workflow, and negative rotation feedback further combined to highlight the imminent need for change.

At first, changes were implemented quickly. The number of residents per month was reduced from 8 to 7, altering the SP1 schedule to a 3-day cycle by removing the frozen/prepping day. Later both services were altered to 3-day cycles, and a resident

was placed on the frozen section service on a weekly basis. By removing the frozen/prepping day from the schedule, issues began to arise with specimen handoffs. These changes did not alter the number of specimens assigned to residents for grossing, and time management problems got worse. Ultimately, it became clear that a formal committee was needed, and extensive data were required to adequately restructure the surgical pathology rotation.

In 2014, a formal restructuring committee was organized with multiple objectives. The first objective of restructuring was to collect data in order to better understand the current state of the surgical pathology rotation with respect to subspecialty volumes and daily variability. The second objective was to investigate resident grossing across different experience levels in order to develop a grossing cap system that would facilitate education, while abiding by duty hours and improving workflow. The third objective of the committee was to use these data to suggest and implement changes to the surgical pathology rotation that would be long-lasting, streamline specimen processing, and most importantly improve resident education while simultaneously improving patient care.

In the sections below, we describe the efforts of the surgical pathology restructuring committee. We describe the data collected, the changes to the rotation that were implemented as a result of these data, and follow-up metrics evaluating the rotation postimplementation of the new rotational structure. We hope that by sharing our experience, other institutions will be able to gain insight into how to go about restructuring their surgical pathology rotations in today's complex landscape.

Materials and Methods

The surgical pathology restructuring committee was composed of both faculty and resident members. First, using the department's Cerner Millennium laboratory information system (Cerner Corporation, North Kansas City, Missouri), a 1-year retrospective review of surgical pathology cases was performed. Cases were identified for inclusion based on the specimen composition as they were coded at the time of accessioning and assigned to the appropriate subspecialty service. Cases grossed by pathologists' assistants were excluded. In order to estimate the workload by subspecialty each day of the week, the average number of cassettes submitted to histology for each specimen type was calculated and used as a "workload score." This workload score was used to estimate the number of cassettes submitted for each subspecialty on each weekday. Using these data, the caseload for hypothetical subspecialty divisions into two overarching services was modeled. The combinations were ranked for parity (equivalent work over a given week) using the difference in the total number of cassettes between the services. The subspecialty divisions were also ranked for consistency (lack of variation in work from day to day). This was determined by calculating the differences in the total number of cassettes on each day of the week between the 2 services. The standard deviation of these 5 values (1 per day of the week) was used as the consistency

score. The product of the parity and consistency scores was used as a general index of the 2 modeled services ranked from lowest disparity (1) to highest disparity (462).

After gaining a better understanding of how the operating room schedule correlated with resident workload, we sought to quantify how the cases themselves translated to grossing time. A survey was created using SurveyMonkey (SurveyMonkey Inc, Palo Alto, California) software and distributed to residents. The survey solicited demographical information about the residents' year in training and grossing speed. Using the notion that 1 point represented 15 minutes of grossing, residents were asked to assign point values to typical and unusual specimens from all organ systems. Each organ system also had an area for comments specific to those specimens. Additional free text answers were offered at the end of the survey for general comments and concerns. This information was considered by the restructuring committee and pathologists' assistants in creating point assignments for different specimens.

After gathering data, brainstorming by the committee, and weeks of planning, a new service structure was implemented in January 2015. After 2 years of the restructured rotation, we retrospectively evaluated various metrics for the time periods before and after the restructuring. First, using our duty hour logging system (MedHub, Minneapolis, Minnesota), we reviewed the reported duty hour violations of the required 8-hour breaks between work periods. Data 6 months before the implementation and 12 months during the new rotation structure were evaluated. Unfortunately, earlier data were not available due to our transition to a new computerized system. Because of the differences in the time periods evaluated, we calculated the average duty hour violations per month on each service before and after the implementation of the new surgical pathology rotation. Data were also collected comparing the turnaround times (time from accession to verification after eliminating weekends) on SP1 and SP2 from January to December 2014 and then again from January to December 2015 for in-house surgical specimens. In addition to evaluating quantitative measures, we sought feedback from a group of residents who had experienced both systems using SurveyMonkey (SurveyMonkey Inc, Palo Alto, California). This survey included a number of statements that trainees were asked to evaluate on a 5-point scale ranging from strongly disagree, disagree, neutral, agree, to strongly agree.

Finally, we reevaluated the point assignments given by the committee at the start of the new rotation structure to see whether adjustments were necessary. Points were assigned according to the established guidelines and assigned to pathologists' assistants. Pathologists' assistants then determined the time they spent grossing these cases to see whether it was consistent with the points assigned (1 point equaling 15 minutes of grossing time). Multiple pathologists' assistants with a variety of grossing experience contributed to this evaluation. By using pathologists' assistants, we hoped to gain a more standardized time not impacted by variations in experience, interests, or habits of trainees. Data collection was targeted on common specimens and those that had been noted to have concerns about point assignments from residents and faculty.

Table 1. Distribution of Subspecialties Into 2 Services Before and After Restructuring.

Service 1	Service 2
Prior to Restructuring	
Gynecologic pathology	Gastrointestinal pathology
Head and neck pathology	Genitourinary pathology
Endocrine pathology	Soft tissue pathology
Breast pathology	Cardiac pathology
Dermatopathology	Pulmonary pathology
	Miscellaneous specimens
After restructuring	
Gynecologic pathology	Gastrointestinal pathology
Endocrine pathology	Genitourinary pathology
Breast pathology	Soft tissue pathology
Pulmonary pathology	Head and neck pathology
Dermatopathology	Cardiac pathology
Miscellaneous specimens	

Results

Using the calculated workload scores, 462 possible subspecialty combinations were modeled with the 10 subspecialties being divided into 2 services. The product of parity (equivalent workload for each service over a given week) and consistency (lack of variation in workload from day to day) was used as a general index to determine the disparity between the 2 modeled services. Using this value, each model was ranked from lowest disparity (1) to highest disparity (462). Our original system was ranked 223.

Following examination of the data and discussion of the various combinations, a service distribution of SP1 including gynecologic pathology, endocrine pathology, breast pathology, pulmonary pathology, dermatopathology and miscellaneous specimens, and SP2 incorporating gastrointestinal pathology, genitourinary pathology, soft tissue pathology, head and neck pathology, and cardiac pathology was selected (Table 1). This distribution of subspecialties ranked 145 of the 462 systems modeled. SP1 became a "1-day cycle" with residents grossing, reviewing, and signing out 1 to 3 organ subspecialties each day. The subspecialties on SP1 were divided into breast, pulmonary/endocrine, and gynecological/dermatopathology with miscellaneous. Each resident rotates in each area for an equivalent number of days per month. SP2 remained a 4-day cycle staffed by 4 residents of frozen, grossing, review, and sign out each occupying an entire day (Table 2).

Twenty-five residents from varying postgraduate years (PGY) completed the grossing time and point assignment survey. Respondents tended to be more junior residents, but all residency years were represented. About half (48%) of the respondents rated their grossing speed as average, with 32% reporting a slow grossing speed and 20% indicating they were fast at grossing (Table 3). Multiple comments addressed how it can be hard to generalize a point value for complex specimens. The variability in time needed to find lymph nodes in colon cases, different challenges raised by discrete palpable masses versus ductal carcinoma in situ in breast specimens, and

Table 2. Organization of Surgical Pathology Rotation Before and After Restructuring.

	Monday	Tuesday	Wednesday	Thursday	Friday	Monday	Tuesday	Wednesday	Thursday	Friday
Prior to Restructuring										
Service 1										
Resident 1	Gross	Review	Sign out	Gross	Review	Sign out	Gross	Review	Sign out	Gross
Resident 2	Review	Sign out	Frozen	Review	Sign out	Frozen	Review	Sign out	Frozen	Review
Resident 3	Sign out	Frozen	Gross	Sign out	Frozen	Gross	Sign out	Frozen	Gross	Sign out
Service 2										
Resident 4	Frozen	Gross	Review	Sign out	Frozen	Gross	Review	Sign out	Frozen	Gross
Resident 5	Gross	Review	Sign out	Frozen	Gross	Review	Sign out	Frozen	Gross	Review
Resident 6	Review	Sign out	Frozen	Gross	Review	Sign out	Frozen	Gross	Review	Sign out
Resident 7	Sign out	Frozen	Gross	Review	Sign out	Frozen	Gross	Review	Sign out	Frozen
After Restructuring										
Service 1										
Resident 1	Gross—breast	Gross—breast	Gross—breast	Gross—breast	Gross—breast	Gross—pulm/endo	Gross—pulm/endo	Gross—pulm/endo	Gross—pulm/endo	Gross—pulm/endo
	Review—breast	Review—breast	Review—breast	Review—breast	Review—breast	Review—breast	Review—breast	Review—breast	Review—breast	Review—breast
	Sign out—breast	Sign out—breast	Sign out—breast	Sign out—breast	Sign out—breast	Sign out—breast	Sign out—breast	Sign out—breast	Sign out—breast	Sign out—breast
Resident 2	Gross—gyn/derm	Gross—gyn/derm	Gross—gyn/derm	Gross—gyn/derm	Gross—gyn/derm	Gross—breast	Review—breast	Gross—breast	Gross—breast	Gross—breast
	Review—gyn/derm	Review—gyn/derm	Review—gyn/derm	Review—gyn/derm	Review—gyn/derm	Review—gyn/derm	Review—breast	Review—breast	Review—breast	Review—breast
	Sign out—gyn/derm	Sign out—gyn/derm	Sign out—gyn/derm	Sign out—gyn/derm	Sign out—gyn/derm	Sign out—gyn/derm	Sign out—gyn/derm	Sign out—gyn/derm	Sign out—gyn/derm	Sign out—gyn/derm
Resident 3	Gross—pulm/endo	Gross—pulm/endo	Gross—pulm/endo	Gross—pulm/endo	Gross—pulm/endo	Gross—pulm/endo	Gross—gyn/derm	Gross—gyn/derm	Gross—gyn/derm	Gross—gyn/derm
	Review—pulm/endo	Review—pulm/endo	Review—pulm/endo	Review—pulm/endo	Review—pulm/endo	Review—pulm/endo	Review—pulm/derm	Review—pulm/derm	Review—pulm/derm	Review—pulm/derm
	Sign out—pulm/endo	Sign out—pulm/endo	Sign out—pulm/endo	Sign out—pulm/endo	Sign out—pulm/endo	Sign out—pulm/endo	Sign out—pulm/derm	Sign out—pulm/derm	Sign out—pulm/derm	Sign out—pulm/derm
Service 2										
Resident 4	Frozen	Gross	Review	Sign out	Frozen	Gross	Review	Sign out	Frozen	Gross
Resident 5	Gross	Review	Sign out	Frozen	Gross	Review	Sign out	Frozen	Gross	Review
Resident 6	Review	Sign out	Frozen	Gross	Review	Sign out	Frozen	Gross	Review	Sign out
Resident 7	Sign out	Frozen	Gross	Review	Sign out	Frozen	Gross	Review	Sign out	Frozen

Abbreviations: Derm, dermatopathology; Endo, endocrine pathology; Gyn, gynecologic pathology; Pulm, pulmonary pathology.

Table 3. Demographic Information for Survey Respondents.

Question	Answer Choice	Number of Respondents	Percentage
What is your PGY year?	1	9	36
	2	9	36
	3	3	12
	4	4	16
How would you rate your grossing speed?	Slow	8	32
	Average	12	48
	Fast	5	20

grossing disparities based on the clinical indication and size of a thyroidectomy specimen are examples of concerns raised by residents in the survey. More general concerns about the new system included the changing role of the pathologists' assistants and turnaround time at histology. Faculty and staff assessed the survey and assigned point values to different specimens with the notion that 1 point is equivalent to 15 minutes of grossing with additional points allocated for subsequent margins and greater complexity (Table 4).

The point system allowed for equivalent distribution of grossing time across the services and the creation of resident grossing caps that take into account resident experience, assist the program in abiding by ACGME work hour regulations, and facilitate workflow to histology. On SP1, senior residents are targeted to gross specimens for 3 hours each day (a maximum of 12 assigned points) and spend the remainder of the day reviewing and signing out. On SP2, senior residents are targeted to gross specimens for 9 hours (a maximum of 36 points) on a day spent entirely grossing. To account for variations in grossing speed due to training level and the need for supervision, the point caps are altered based on the months of service experience the resident has (Table 5). Once the resident point caps are attained, the remaining specimens for the day are assigned to pathologists' assistants for grossing. Depending on the subspecialty, the sign out responsibility for these cases either goes to the resident or gets reaccessioned to a surgical pathology fellow for review and sign out. In order to keep track of the points assigned to each resident and to track changes in grossing volumes, a database system was developed.

After implementation, we analyzed metrics from before and after the restructuring. We reviewed reported duty hour violations of the required 8-hour break between work periods. In the 6-month period from July 2014 until December 2014, there was an average of 0.67 violations per month on SP1 which decreased to 0.25 violations per month during the 12-month period from January 2015 until December 2015. On SP2, there was an average of 1 violation per month prior to the restructuring and 0.25 violations afterward. Therefore, with the

implementation of the new service structure, the reported number of 8-hour duty violations decreased on both services (Table 6). Turnaround time data for in-house surgical pathology specimens improved when compared to the year before the transition (January 2014-December 2014) and the year after the transition (January 2015-December 2015). On SP1, the percentage of cases with a turnaround time equal to or less than 72 hours increased from 71.9 to 78.2. Similarly on SP2, the percentage of cases with a turnaround time equal to or less than 72 hours increased from 85.1 to 88.1 (Table 7). Although these results may result from the retrospective nature of the data or the presence of unaccounted confounders, we are encouraged by the overall positive trends in trainee experience and workflow.

Review of the originally assigned point values to each specimen by the pathologists' assistants identified a few specimens needing point adjustments (Table 8). The value assigned for breast partial mastectomies and skin wide excisions decreased, as the grossing time was found to be faster than that reflected by the point assignment. Conversely, the point assignments for bilateral lung explants, liver explants, and heart explants increased as the grossing time was slower than the time reflected by the point assignment. Other specimens had slight skewing of grossing times that will be reassessed over time to see whether point value change is necessary.

A retrospective survey of residents who had experienced the surgical pathology rotation prior to and after restructuring was generally positive (Table 9). Notably, all respondents agreed (86%) or strongly agreed (14%) that the ability to follow up and learn from pending cases on SP1 had improved. Furthermore, all respondents agreed (71.5%) or strongly agreed (28.5%) that transition to a 1-day cycle for certain organ systems was beneficial for learning. The point system was noted by all respondents to be an improved way of estimating grossing workload compared to specimen counts (57% agree and 43% strongly agree). Overall perceptions of the changes were more favorable for SP1 with 83% of respondents agreeing that overall education on SP1 had improved, while only 34% agreed this was the case on SP2. In terms of wellness, 66% agreed overall wellness on SP1 had improved and 50% felt this way about SP2. Forty-three percent of respondents did not feel that it was easier to abide by duty hour regulations on SP1 following the restructuring. Further, residents commented that the escalation of the point caps on SP2 was too severe and requested a more gradual increase in points based on experience.

Discussion

Surgical pathology rotations are a fundamental aspect of anatomic pathology training. These rotations not only teach pathology residents medical knowledge but are also essential in patient care, patient safety, leadership, and laboratory management. As the practice of pathology continues to evolve, pathology residency training must address changes in the field to ensure a competent and successful workforce. At our institution, restructuring of the surgical pathology rotation proved necessary in 2012. Despite initial efforts, it became clear that a

Table 4. Point Values Assigned to Common Specimens.*†

Subspecialty	Tissue Type	Points at Restructuring Implementation	Points Post Feedback
Breast	Bilateral mastectomies with bilateral tumors and bilateral axillary dissections	7	7
Breast	Bilateral mastectomies with bilateral tumors	5	5
Breast	Bilateral mastectomies with tumor in only 1 breast	4	4
Breast	Bilateral mastectomies with tumor in only 1 breast and axillary dissection	5	5
Breast	Unilateral mastectomy without tumor	2	2
Breast	Unilateral mastectomy with tumor	3	3
Breast	Oriented partial mastectomy, oriented	2	1
Breast	Oriented partial mastectomy with margins	3	3
Cardiovascular	Native heart	2	3
Dermatopathology	Wide excision of skin, <3 cm in greatest dimension	1	1
Dermatopathology	Wide excision of skin, >3 cm in greatest dimension	2	1*
Endocrine	Adrenal resection	2	2
Endocrine	Thyroid lobectomy	1	1
Endocrine	Total thyroid, <100 grams	2	2
Endocrine	Total thyroid, >100 grams	3	3
Head and neck	Partial laryngectomy	2	2
Head and neck	Total laryngectomy	3	3
Head and neck	Maxillectomy/mandiblectomy	4	4
Head and neck	Neck dissection (oriented with multiple levels)	3	3
Head and neck	Pharynx resection	2	2
Head and neck	Salivary gland, <3 cm in greatest dimension	1	1
Head and neck	Salivary gland, >3 cm in greatest dimension	2	2
Head and neck	Tongue resection for tumor	3	3
Head and neck	Tonsil resection for tumor	2	2
Genitourinary	Cystoprostatectomy	4	4
Genitourinary	Cystectomy	3	3
Genitourinary	Nephrectomy	2	2
Genitourinary	Partial nephrectomy	1	1
Genitourinary	Prostatectomy	3	3
Genitourinary	Orchiectomy for tumor	2	2
Genitourinary	Orchiectomy for castration	1	1
Genitourinary	Nephrectomy with ureter resection	2	2
Gastrointestinal	Colon resection for inflammatory bowel disease	3	3
Gastrointestinal	Colon resection for invasive tumor	3	3
Gastrointestinal	Colon resection for noninvasive tumor	4	4
Gastrointestinal	Distal pancreatectomy and splenectomy	3	3
Gastrointestinal	Esophagectomy	3	3
Gastrointestinal	En bloc exenteration for gastrointestinal primary	5	5
Gastrointestinal	Native liver without tumor	3	4
Gastrointestinal	Native liver with tumor	4	5†
Gastrointestinal	Hepatectomy without tumor	1	1
Gastrointestinal	Hepatectomy with tumor	2	2
Gastrointestinal	Low anterior resection (rectum/anus)	4	5
Gastrointestinal	Small bowel resection for inflammatory bowel disease	2	2
Gastrointestinal	Gastrectomy with tumor	4	4
Gastrointestinal	Gastrectomy for mutation carrier without prior cancer diagnosis	5	6
Gastrointestinal	Gastrectomy without tumor	1	1
Gastrointestinal	Whipple resection	4	4
Gynecological	En bloc exenteration for gynecological primary	3	3
Gynecological	Bilateral oophorectomy for BRCA mutation	1	2
Gynecological	Oophorectomy with or without salpingectomy, tumor/mass <5 cm	1	1
Gynecological	Oophorectomy with or without salpingectomy, tumor/mass >5 cm	2	2
Gynecological	Radical hysterectomy for cervical cancer	3	3
Gynecological	Hysterectomy with leiomyoma	2	1
Gynecological	Hysterectomy with malignancy/hyperplasia	3	3

(continued)

Table 4. (continued)

Subspecialty	Tissue Type	Points at Restructuring Implementation	Points Post Feedback
Gynecological	Uterus without tumor	1	1
Gynecological	Oriented vulvectomy	2	2
Miscellaneous	Amputation without tumor	2	2
Pulmonary	Lobectomy with tumor	2	2
Pulmonary	Lobectomy with chest wall resection	4	2
Pulmonary	Bilateral native lungs	3	5
Pulmonary	Unilateral native lungs	2	2
Pulmonary	Pneumonectomy with tumor	2	2
Pulmonary	Wedge biopsy	1	1
Pulmonary	Lung wedge with completion lobectomy for tumor	3	3
Pulmonary	Mediastinal mass resection	2	2
Pulmonary	Extrapulmonary pneumonectomy for mesothelioma	3	3
Soft Tissue	Resection of bone tumor	4	4
Soft Tissue	Soft tissue tumor resection, <3 cm in greatest dimension	1	1
Soft Tissue	Soft tissue tumor resection, >3 cm in greatest dimension	2	2

*Skin ellipses >10 cm are now assigned 2 points.
 †Additional liver lesions add 1 point per lesion.

Table 5. Point Caps for Grossing Depending on Month on Service.

Month On Service	Service 1	Service 2 At Restructuring Implementation	Service 2 Post Feedback
First month	8	24	24
Second month	10	30	24
Third month	12	36	30
Fourth month	12	36	30
Additional months	12	36	36

Table 6. Duty Hour Violations Reported Before and After Restructuring.

Service	Time Period	8-Hour Duty Hour Violations Reported	Average Violations Per Month
Service 1	Before restructuring July 2014-December 2014 (6 months)	4	0.67
	After restructuring January 2015-December 2015 (12 months)	3	0.25
Service 2	Before restructuring July 2014-December 2014 (6 months)	6	1
	After restructuring January 2015-December 2015 (12 months)	3	0.25

systematic, data-based method was needed by which to guide the restructuring process. By accumulating and analyzing data from our pathology information system and through various

Table 7. Time From Accessioning to Verification (Turnaround Time) Before and After Restructuring.

Service	Time Period	Turnaround Time ≤ 72 hours	Turnaround Time > 72 hours
Service 1	Before restructuring January 2014-December 2014	71.9%	28.1%
	After restructuring January 2015-December 2015	78.2%	21.8%
Service 2	Before restructuring January 2014-December 2014	85.1%	14.9%
	After restructuring January 2015-December 2015	88.1%	11.9%

surveys, we were able to restructure our surgical pathology rotation. The new version of our rotation has been in place now for 2 years.

The use of quantitative data was important in our restructuring process. At the same time, information had to be interpreted and implemented with consideration of other factors specific to our institution. These included optimizing sign out times with attending schedules to ensure a favorable workflow. For example, because miscellaneous specimens are signed out by the attending on the dermatopathology service, those specimens were moved to SP1 to allow a single resident to sign out dermatopathology and miscellaneous cases with the attending at 1 scheduled sign out time rather than having 2 residents on 2 different services involved in signing out at 2 different scheduled times.

Another decision that was critical to the restructuring process was the decision to create a hybrid model of service structure resulting in a 1-day cycle for SP1 and a 4-day cycle for

Table 8. Grossing Times in Relationship to Point Values Observed After Restructuring.

Subspecialty	Specimen Type	Actual Time	Actual Time	Actual Time	Total Cases
		Faster than Points	Equal to Points	Slower than Points	
Breast	Mastectomy	1 (33.3%)	1 (33.3%)	1 (33.3%)	3
Breast	Partial mastectomy	16 (57.1%)	10 (35.7%)	2 (7.1%)	28
Cardiovascular	Native heart	0	0	5 (100%)	5
Dermatopathology	Wide excision of skin	13 (100%)	0	0	13
Endocrine	Thyroid lobectomy	0	2 (66.6%)	1 (33.3%)	3
Endocrine	Total thyroid	1 (25%)	2 (50%)	1 (25%)	4
Head and neck	Salivary gland with/without neck dissection	1 (50%)	1 (50%)	0	2
Head and neck	Oropharynx/partial laryngectomy with/without neck dissection	1 (33.3%)	1 (33.3%)	1 (33.3%)	3
Head and neck	Neck dissection alone	1 (100%)	0	0	1
Genitourinary	Prostatectomy	7 (43.7%)	7 (43.7%)	2 (12.5%)	16
Genitourinary	Nephrectomy/partial nephrectomy	0	0	3 (100%)	3
Genitourinary	Orchiectomy	1 (50%)	0	1 (50%)	2
Gastrointestinal	Colon resection, various	0	5 (62.5%)	3 (37.5%)	8
Gastrointestinal	Hepatectomy, various	1 (33.3%)	2 (66.6%)	0	3
Gastrointestinal	Gastrectomy without tumor	0	7 (100%)	0	7
Gastrointestinal	Native liver with/without tumor	0	0	3 (100%)	3
Gastrointestinal	Small bowel resection, various	0	2 (66.6%)	1 (33.3%)	3
Gynecological	Hysterectomy with malignancy/hyperplasia	1 (12.5%)	5 (62.5%)	2 (25%)	8
Gynecological	Hysterectomy with leiomyoma	0	1 (100%)	0	1
Gynecological	Bilateral oophorectomy for BRCA	0	0	1 (100%)	1
Gynecological	Oophorectomy with salpingectomy	1 (100%)	0	0	1
Miscellaneous	Amputation without tumor	0	3 (75%)	1 (25%)	4
Pulmonary	Unilateral native lung	0	0	2 (100%)	2
Pulmonary	Bilateral native lungs	0	0	7 (100%)	7
Pulmonary	Lung wedge	1 (33.3%)	2 (66.6%)	0	3
Pulmonary	Lung lobectomy with tumor	0	3 (75%)	1 (25%)	4
Pulmonary	Mediastinal mass	1 (33.3%)	2 (66.6%)	0	3

SP2. The exploration and implementation of a 1-day cycle were new at our institution. A 1-day cycle was felt to offer several advantages for education. Rather than a resident signing out with an attending once in a 4-day period, residents on SP1 sign out daily leading to greater attending–resident interaction. The daily sign out also facilitates follow-up on pending cases when ancillary studies are needed. Further, by concentrating on 1 or 2 organ systems for a series of days, residents are able to target their learning and better consolidate information. In our implementation of the 1-day cycle, the grossing residents are not the same ones that prepare the specimens prior to fixation. Therefore, subspecialties composing the new SP1 were chosen in part as a result of their less complex specimens leading to the ability of residents to gross them with ease without seeing them fresh. The pulmonary service was specifically transferred to the SP1 1-day cycle to allow follow up and discussion of ancillary studies and final interpretations with the attending pathologist in a timely manner. In the age of precision medicine and standard of care workups for pulmonary specimens, this has drastically improved the educational experience for our residents.

The follow-up survey of residents confirmed many of our positive opinions of the 1-day cycle; however, there were some less favorable aspects to the 1-day schedule highlighted by the

resident survey. Residents noted that sometimes the prepping or handoff of the specimens from the prepping team was subpar. Since the survey, more emphasis has been placed on transition of care to facilitate more successful handoffs. Furthermore, in order to address resident concerns about education and wellness on SP2, the grossing caps correlating with each month on service were adjusted (Table 5).

The 4-day cycle was maintained on SP2 for various reasons. Gastrointestinal, head and neck, and genitourinary pathology services receive complicated and variable specimens requiring meticulous inking and processing, creating challenges for transition of care. As a result, it was felt best to have these organ systems remain on a 4-day cycle, allowing the same resident who received the specimen fresh, and in some instances discussed the case directly with the surgeon, to gross the specimen and see it through to sign out. Interestingly, our head and neck surgeons strongly advocated for the retention of the 4-day cycle, feeling it is ideal for patient care when they can orient a specimen with the specific resident who will be handling the grossing. Further, SP2 provides for an uninterrupted full-day review period, which according to many of the residents provides them with the time necessary to fully review and prepare these cases.

Table 9. Results of Resident Survey Evaluating the Surgical Pathology Rotation Before and After Restructuring.

Question	Answer Choice	Respondents	Percentage
What is your PGY year?	3	3	43
	4+	4	57
The ability to follow up and learn from pending cases on service 1 has improved	Strongly disagree	0	0
	Disagree	0	0
	Neutral	0	0
	Agree	6	86
The ability to follow up and learn from pending cases on service 2 has improved	Strongly disagree	0	0
	Disagree	0	0
	Neutral	4	57
	Agree	3	43
It is easier to abide by duty hour regulations on service 1	Strongly disagree	0	0
	Disagree	3	43
	Neutral	0	0
	Agree	2	28.5
	Strongly agree	2	28.5
It is easier to abide by duty hour on service 2 regulations	Strongly disagree	0	0
	Disagree	0	0
	Neutral	3	43
	Agree	2	28.5
The 1-day cycle that allows for more targeted learning of specific organ systems is beneficial for learning.	Strongly disagree	0	0
	Disagree	0	0
	Neutral	0	0
	Agree	5	71.5
The 4-day cycle that allows for a single task (frozens/grossing/reviewing/signing out) on a single day is beneficial for learning.	Strongly disagree	0	0
	Disagree	0	0
	Neutral	2	28.5
	Agree	3	57
The points system is an improved way of estimating grossing workload compared to specimen counts	Strongly disagree	0	0
	Disagree	0	0
	Neutral	0	0
	Agree	4	57
Overall education on service 1 has improved	Strongly disagree	0	0
	Disagree	1	17
	Neutral	0	0
	Agree	5	83
	Strongly agree	0	0

(continued)

Table 9. (continued)

Question	Answer Choice	Respondents	Percentage
Overall education on service 2 has improved	Strongly disagree	0	0
	Disagree	0	0
	Neutral	4	66
	Agree	2	34
Overall wellness on service 1 has improved	Strongly disagree	0	0
	Disagree	1	17
	Neutral	1	17
	Agree	4	66
Overall wellness on service 2 has improved	Strongly disagree	0	0
	Disagree	0	0
	Neutral	3	50
	Agree	3	50
	Strongly agree	0	0

The points-based system for grossing distribution developed during the restructuring effort has been particularly successful as it allows for an estimation of work hours required by trainees to gross different specimens independent of the organization of the rotation. Surveyed residents felt this points system estimated grossing workload far better than any of the prior systems used. The points assigned per specimen is open to ongoing feedback, with residents reviewing their assigned points with the pathologists' assistants on a daily basis. Further, using data collected by the pathologists' assistants, we were able to tweak the point allocations for several specimens. The system also allows for complex and unusual specimens to be assigned unique point values as needed. Finally, the point system allows for graduated responsibility as the total points grossed by a resident in a particular time period can be increased or decreased based on the resident's experience and efficiency. We strongly feel that the point system can be applied in any training program as it provides a reproducible and reliable way to quantify the time required for residents to gross a combination of various specimens.

One issue we encountered with the point system was that it did not take into account additional specimens assigned to the residents for review and sign out. We continue to monitor the number of specimens reviewed and signed out by the residents, which in many instances include both the cases they have grossed and the "overcap" cases grossed by the pathologists' assistants. Some services have elected to have the cases grossed by the pathologists' assistants reaccessioned to the surgical pathology fellow on the appropriate service in order to further manage the resident workload. The optimal way to distribute overcap cases for both the workload and learning of the residents and fellows continues to be discussed and is certainly an avenue for further investigation.

Given all the changes instituted to the surgical pathology rotation, we solicited feedback on the rotation before and after restructuring. Overall the surveys showed a positive response to the changed rotation via both quantitative metrics and subjective feedback. The residents had a particularly favorable response to the points-based system for assigning specimens. The residency program and surgical pathology leadership also found this tool useful and it continues to be used in fine-tuning the surgical pathology rotation to maintain education and wellness. Although our major restructuring efforts were undertaken during the time of extensive work hour limitations by the ACGME on PGY1 residents, which have subsequently changed, we plan to continue with the new structure of our rotation, given the overall increase in resident satisfaction.

In conclusion, we strongly feel that our experience at the Hospital of the University of Pennsylvania is applicable to other anatomic pathology training programs, at tertiary care centers, smaller academic centers, and community hospitals. Our data-based approach is relevant not only to residency training but also to laboratory leaders who struggle to predict workload and how to properly allocate personnel and resources to address their workload. Techniques that provide data to monitor resident and staff workload will only continue to become increasingly important with the evolution of both residency training and the field of pathology as a whole. Our restructuring experience continues to evolve and the surgical pathology restructuring committee continues to meet frequently to discuss the surgical pathology resident rotation as well as the surgical pathology and histology workflow. In the future, we hope to further look back on our experience and adopt this approach to how we evaluate our resident training activities.

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